

Claims:

1. A tubing connection arrangement comprising:
a first expandable tubing section defining a male portion;
a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another;
one of the first and second expandable tubing sections including a restraining member for restraining part of the other expandable tubing section; and
the first expandable tubing section including a tapered shoulder for co-operating with a corresponding tapered shoulder of the second expandable tubing section.
2. A tubing connection arrangement as claimed in claim 1, wherein the first expandable tubing section includes first and second axially spaced shoulders for co-operating with corresponding first and second axially spaced shoulders of the second expandable tubing section.
3. A tubing connection arrangement as claimed in claim 1, wherein the shoulder comprises a face of the respective expandable tubing section.
4. A tubing connection arrangement as claimed in claim 3, wherein the face is formed on an axial end of the respective tubing section.
5. A tubing connection arrangement as claimed in claim 1, wherein the expandable tubing sections include a radially extending shoulder member defining the shoulder.

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

6. A tubing connection arrangement as claimed in claim 2, wherein each expandable tubing section includes a first shoulder comprising a face on an axial end thereof and a radially extending shoulder member defining a second shoulder.
7. A tubing connection arrangement as claimed in claim 1, wherein the shoulders of the first and second expandable tubing sections are adapted to define a gap between their respective tapered surfaces when the first and second expandable tubing sections are engaged and before expansion of the connection arrangement.
8. A tubing connection arrangement as claimed in claim 7, wherein the gap is adapted to close on expansion of the connection arrangement to bring the tapered surfaces into contact.
9. A tubing connection arrangement as claimed in claim 1, wherein the restraining member extends from an axial end of the second expandable tubing section.
10. A tubing connection arrangement as claimed in claim 9, wherein the restraining member extends from the female portion of the second expandable tubing section.
11. A tubing connection arrangement as claimed in claim 1, wherein the restraining member is adapted to extend in an axial direction along an outer surface of part of the first expandable tubing section.
12. A tubing connection arrangement as claimed in claim 1, wherein the restraining member is adapted to extend in an axial direction along an outer surface of part of the second expandable tubing section.

13. A tubing connection arrangement as claimed in claim 1, wherein the restraining member comprises a sleeve.
14. A tubing connection arrangement as claimed in claim 13, wherein the sleeve comprises slotted tubing.
15. A tubing connection arrangement as claimed in claim 13, wherein the sleeve defines a number of separate arms or fingers.
16. A tubing connection arrangement comprising:
a first expandable tubing section defining a threaded male portion having lead and back thread flanks; and
a second expandable tubing section defining a threaded female portion having lead and back thread flanks, the first and second expandable tubing sections being engageable with one another;
the lead thread flanks of the threaded male portion disposed at an angle different from that of the lead thread flanks of the threaded female portion.
17. A tubing connection arrangement as claimed in claim 16, wherein the difference between the angles of the lead thread flanks of the male and female portions is less than 10° .
18. A tubing connection arrangement as claimed in claim 17, wherein the difference is between 1 and 5° .
19. A tubing connection arrangement as claimed in claim 17, wherein the difference is approximately 2° .

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

20. A tubing connection arrangement as claimed in claim 16, wherein the lead thread flanks of the threaded male portion are disposed at 45° with respect to a main thread axis.

21. A tubing connection arrangement as claimed in claim 16 wherein the lead thread flanks of the threaded female portion are disposed at 43° with respect to a main thread axis.

22. A tubing connection arrangement as claimed in claim 16, wherein the lead thread flanks of the threaded male portion are disposed at 43° and the lead thread flanks of the threaded female portion at 45° with respect to a main thread axis.

23. A tubing connection arrangement as claimed in claim 16, wherein the back thread flanks of the threaded male and female portions are disposed at an acute angle with respect to a main thread axis such that the respective thread portions are angled away from an adjacent end of the respective tubing section, to define a hook profile.

24. A tubing connection arrangement comprising:

a first expandable tubing section defining a threaded male portion having lead and back thread flanks; and

a second expandable tubing section defining a threaded female portion having lead and back thread flanks, the first and second expandable tubing sections being engageable with one another;

the back thread flanks of the threaded male and female portions being disposed at an acute angle with respect to respective main thread axes such that the respective thread portions are angled away from an adjacent end of the respective tubing section.

25. A tubing connection arrangement as claimed in claim 24, wherein the acute angle is between 40 and 90°.
26. A tubing connection arrangement as claimed in claim 25, wherein the acute angle is approximately 83°.
27. A tubing connection arrangement as claimed in claim 24, wherein the lead thread flanks of the threaded male portion are disposed at an angle different from that of the lead thread flanks of the threaded female portion.
28. A tubing connection arrangement comprising:
a first expandable tubing section defining a male portion;
a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another; and
at least one of the first and second expandable tubing sections including an axially deformable member adapted to deform on engagement of the first and second expandable tubing sections with one another.
29. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is adapted to deform on engagement of the first and second expandable tubing sections to impart a force on the male and female portions.
30. A tubing connection arrangement as claimed in claim 28, wherein the male and female portions are threaded such that the deformable member pre-loads the threads of the threaded male and female portions when deformed.
31. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is dimensioned to allow a number of sequential partial deformations.

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

32. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is diametrically expandable.
33. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is partially plastically and elastically deformable.
34. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is wholly elastically deformable.
35. A tubing connection arrangement as claimed in claim 28, wherein the deformable member is an integral part of the respective expandable tubing section.
36. A tubing connection arrangement as claimed in claim 28, wherein the deformable member comprises a separate component of the respective expandable tubing section.
37. A tubing connection arrangement as claimed in claim 28, wherein the deformable member comprises a diametrically expandable ring.
38. A tubing connection arrangement as claimed in claim 37, wherein the deformable member comprises a slotted ring.
39. A tubing connection arrangement as claimed in claim 37, wherein the deformable member comprises separate sections together forming a ring.
40. A tubing connection arrangement as claimed in claim 28, wherein both the first and second expandable tubing sections include an axially deformable member.
41. A tubing connection arrangement as claimed in claim 28, wherein the first expandable tubing section includes a shoulder for co-operating with a corresponding shoulder of the second expandable tubing section.

42. A tubing connection arrangement as claimed in claim 41, wherein the deformable member is locatable between the shoulders of the first and second expandable tubing sections.

43. A tubing connection arrangement comprising:

a first expandable tubing section defining a male portion;

a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another; and

one of the first and second expandable tubing sections including a restraining member for restraining part of the other expandable tubing section, the restraining member including a hinge about which the restraining member is adapted to bend on expansion.

44. A tubing connection arrangement as claimed in claim 43, wherein the restraining member extends from an axial end of the second expandable tubing section.

45. A tubing connection arrangement as claimed in claim 44, wherein the restraining member extends from the female portion.

46. A tubing connection arrangement as claimed in claim 43, wherein the restraining member comprises a sleeve adapted to extend in an axial direction around an outer surface of part of the first expandable tubing section.

47. A tubing connection arrangement as claimed in claim 43, wherein the hinge is integral with the restraining member.

48. A tubing connection arrangement as claimed in claim 47, wherein the hinge comprises a living hinge.

49. A tubing connection arrangement as claimed in claim 43, wherein the hinge is defined by a zone of weakness in the restraining member.

50. A tubing connection arrangement as claimed in claim 49, wherein the zone of weakness comprises an area of relatively thin cross-sectional thickness than a remainder of the restraining member.

51. A tubing connection arrangement as claimed in claim 43, wherein the restraining member comprises a separate component coupled to the respective expandable tubing section to form a hinge therebetween.

52. A tubing connection arrangement as claimed in claim 51, wherein the restraining member comprises a sleeve.

53. A tubing connection arrangement as claimed in claim 51, wherein the restraining member comprises a plurality of arms.

54. A tubing connection arrangement as claimed in claim 43, wherein the restraining member includes a plurality of axially spaced hinges about which the restraining member is adapted to pivot on expansion.

55. A tubing connection arrangement as claimed in claim 43, wherein the hinge is provided in the same axial position of the restraining member as a bending zone on the overlapped expandable tubing section.

56. A tubing connection arrangement comprising:
a first expandable tubing section defining a threaded male portion;

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

a second expandable tubing section defining a threaded female portion, the first and second expandable tubing sections being engageable with one another; and

wherein a cross-sectional thickness of the first expandable tubing section is greater in the region of the male threaded portion than at a point axially spaced from the male threaded portion.

57. A tubing connection arrangement as claimed in claim 56, wherein the point is spaced axially from the male portion in a direction away from an end of the first expandable tubing section defining the male portion.

58. A tubing connection arrangement as claimed in claim 56, wherein the point comprises an area extending at least part way along a length of the first expandable tubing section immediately adjacent the male portion.

59. A tubing connection arrangement as claimed in claim 56, wherein the first expandable tubing section includes a shoulder for co-operating with a corresponding shoulder of the second expandable tubing section.

60. A tubing connection arrangement as claimed in claim 59, wherein the point is immediately adjacent the shoulder of the first expandable tubing section.

61. A tubing connection arrangement comprising:

a first expandable tubing section defining a threaded male portion and a threaded radial hole extending through the threaded male portion and adapted to receive a threaded locking member;

a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another and the second expandable tubing section including a bore extending through the threaded

female portion and adapted to receive the threaded locking member when the threaded hole of the first expandable tubing section is aligned with the bore of the second expandable tubing section, for restraining the sections against relative rotation.

62. A tubing connection arrangement comprising:

a first expandable tubing section including a perforated inner expandable tubing defining a continuous annular ring at an axial end thereof; a male portion; and a threaded radial hole formed in the perforated inner expandable tubing with a solid unperforated tubing wall section extending axially between the hole and the ring, the hole adapted to receive a threaded locking member; and

a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another and the second expandable tubing section including a bore adapted to receive the threaded locking member when the threaded hole of the first expandable tubing section is aligned with the bore of the second expandable tubing section, for restraining the sections against relative rotation.

63. A tubing connection arrangement comprising:

a first expandable tubing section defining a male portion;

a second expandable tubing section defining a female portion, the first and second expandable tubing sections being engageable with one another; and

the first expandable tubing section including first and second axially spaced shoulders for co-operating with corresponding first and second axially spaced shoulders of the second expandable tubing section, the length of the male portion between the first and second shoulders being selected to minimise bending of the male and female portions on expansion.

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

64. A tubing connection arrangement as claimed in claim 63, wherein the male and female portions are threaded.

65. A tubing connection arrangement as claimed in claim 64, wherein a majority of the length of the male and female portions between the respective first and second shoulders is threaded.

66. A tubing connection arrangement as claimed in claim 65, wherein more than half of the length between the respective first and second shoulders is threaded.

67. A tubing connection arrangement as claimed in claim 1, wherein each expandable tubing section comprises a filter screen mounted around an inner expandable tubing.

68. A tubing connection arrangement as claimed in claim 1, wherein each tubing section comprises a filter screen sandwiched between inner expandable tubing and outer protective expandable tubing.

69. A tubing connection arrangement as claimed in claim 67, wherein the inner and outer expandable tubings comprise perforated tubing such as slotted tubing.

70. A tubing connection arrangement as claimed in claim 67, wherein each filter screen comprises a plurality of overlapping sheets individually mounted to the respective inner expandable tubing by axially parallel fixings.

71. A tubing connection arrangement as claimed in claim 1, wherein one of the first and second expandable tubing sections includes a restraining member for restraining part of the other expandable tubing section, a length of the restraining member selected to maximise axial overlap between a filter screen of the respective expandable tubing section and slots in an inner support tubing of the respective expandable tubing section.

72. A tubing connection arrangement as claimed in claim 1, wherein the male portion of the first expandable tubing section comprises a pin and the female portion of the second expandable tubing section comprises a box.

73. A tubing connection arrangement as claimed in claim 1, wherein the male and female portions of the first and second expandable tubing sections define upsets.

74. A tubing connection arrangement as claimed in claim 1, wherein the tubing connection arrangement is a downhole tubing connection arrangement.

75. Downhole tubing comprising a tubing connection arrangement as claimed in claim 1.

76. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a male portion and a respective tapered shoulder;

providing a second expandable tubing section defining a female portion and a respective tapered shoulder;

providing a restraining member on one of the first and second expandable tubing sections; and

coupling the first and second expandable tubing sections together such that the restraining member restrains part of said other expandable tubing section and such that said shoulders are brought into engagement.

77. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a threaded male portion having respective lead and back thread flanks;

providing a second expandable tubing section defining a female threaded portion having respective lead and back thread flanks, the lead thread flanks of the threaded male portion disposed at an angle different from that of the lead thread flanks of the threaded female portion; and

coupling the first and second expandable tubing sections together.

78. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a threaded male portion having lead and back thread flanks; and

providing a second expandable tubing section defining a threaded female portion having lead and back thread flanks, the back thread flanks of the threaded male and female portions being disposed at an acute angle with respect to respective main thread axes such that the respective thread portions are angled away from an adjacent end of the respective tubing section; and

coupling the first and second expandable tubing sections together.

79. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a male portion;

providing a second expandable tubing section defining a female portion;

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

providing at least one of the first and second expandable tubing sections with an axially deformable member; and

coupling the first and second expandable tubing sections together to deform the deformable member and impart a force on the male and female portions.

80. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a male portion;

providing a second expandable tubing section defining a female portion;

providing one of the first and second expandable tubing sections with a restraining member having a hinge about which the restraining member is adapted to bend on expansion; and

coupling the first and second expandable tubing sections together such that the restraining member restrains part of said other expandable tubing section.

81. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a threaded male portion;

providing a second expandable tubing section defining a threaded female portion, a cross-sectional thickness of the first expandable tubing section being greater in the region of the male threaded portion than at a point axially spaced from the male threaded portion; and

coupling the first and second expandable tubing sections together.

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

82. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a threaded male portion having a threaded radial hole extending therethrough;

providing a second expandable tubing section defining a female portion having a bore extending therethrough;

coupling the first and second expandable tubing sections together;

aligning the threaded radial hole with the bore; and

locating a threaded locking member in the aligned radial hole and bore for restraining the sections against relative rotation.

83. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section including a perforated inner expandable tubing defining a continuous annular ring at an axial end thereof; a male portion; and a threaded radial hole formed in the perforated inner expandable tubing with a solid unperforated tubing wall section extending axially between the hole and the ring;

providing a second expandable tubing section defining a female portion including a bore;

coupling the first and second expandable tubing sections together;

aligning the threaded radial hole with the bore; and

locating a threaded locking member in the aligned radial hole and bore for restraining the sections against relative rotation.

PATENT

Attorney Docket No.: MRKS/0121

Express Mail No.: EV 349852302 US

84. A method of coupling expandable tubing sections together, the method comprising the steps of:

providing a first expandable tubing section defining a male portion including first and second axially spaced shoulders;

providing a second expandable tubing section defining a female portion including first and second axially spaced shoulders;

selecting the length of the male portion between the first and second shoulders to minimise bending of the male and female portions on expansion; and

coupling the first and second expandable tubing sections together such that said respective first and second shoulders of the first and second expandable tubing sections are brought into engagement.